

We claim:

1. A fade-resistant forward error correction (FEC) method for a free-space optical communications system, comprising:

encoding user input data with a FEC to produce encoded user data;

producing a plurality of encoded user data channels from said

5 encoded user data, wherein each particular channel of said delayed encoded user data channels comprises a unique delay relative to all of the other channels of said plurality of encoded user data channels;

a step for transmitting said plurality of encoded user data channels across a free space optical channel;

10 a step for receiving said plurality of encoded user data channels and separating each channel from said plurality of encoded user data channels;

detecting each said plurality of received beams;

adjusting selected ones of said received beams so all of them are temporally equal;

15                    decoding said received beams; and  
                      sending the first successfully decoded received beam as a recovered  
user data output.

2. The method of claim 1, wherein the step for transmitting said  
plurality of encoded user data channels across a free space optical channel  
comprises modulating said plurality of encoded user data channels with a  
modulation scheme selected from the group consisting of amplitude modulation,  
5                    frequency modulation and phase modulation.

3. The method of claim 1,  
                      wherein said step for transmitting said plurality of encoded user data  
channels across a free space optical channel comprises:  
                      driving a separate ultra-dense wavelength division multiplexing  
5                    (UDWDM) laser with each channel of said plurality of encoded user data  
channels, wherein each UDWDM laser produces an output beam that operates as  
a carrier of the encoded user data information in a particular channel of said  
plurality of encoded user data channels;

                      combining all of the output beams in a wavelength division  
10                    multiplexing multiplexor (WDM-MUX) to produce a combined beam; and

transmitting said combined beam across said free-space optical channel,

wherein said step for receiving said plurality of encoded user data channels and separating each channel from said plurality of encoded user data

15 channels comprises:

separating said combined beam into a plurality of received beams, wherein each received beam corresponds to a particular output beam of a particular said UDWDM laser.

4. The method of claim 1,

wherein said step for transmitting said plurality of encoded user data channels across a free space optical channel comprises:

5 in a M-ary phase shift keying (PSK) encoder, PSK encoding each said particular channel to combine a plurality of PSK encoded channels in a PSK transmission channel;

driving an optical phase modulator (OPM) with said PSK transmission channel;

10 modulating an UDWDM laser with said OPM to produce an OPM channel; and

transmitting said OPM channel across a free-space optical channel to produce a transmitted beam,

wherein said step for receiving said plurality of encoded user data channels and separating each channel from said plurality of encoded user data channels comprises:

in a M-ary optical phase decoder, decoding said transmitted beam into a plurality of received beams, wherein each received beam corresponds to a particular channel of said delayed encoded user data channels.

5. The method of claim 1,

wherein said step for transmitting said plurality of encoded user data channels across a free space optical channel comprises:

in a first quadrature phase shift keying (QPSK) encoder, QPSK encoding a first group of at least two channels of said encoded user data channels and combining said first group in said first QPSK encoder into a first QPSK transmission channel;

driving a first optical phase modulator (OPM) with said first QPSK transmission channel;

modulating a first laser beam produced by a first UDWDM laser with said first OPM to produce a first OPM channel;

in a second quadrature phase shift keying (QPSK) encoder, QPSK encoding a second group of at least two channels of said encoded user data

channels and combining said second group in said second QPSK encoder into a  
15 second QPSK transmission channel;

driving a second optical phase modulator (OPM) with said second  
QPSK transmission channel;

modulating a second laser beam produced by a second UDWDM laser  
with said second OPM to produce a second OPM channel;

20 combining first OPM channel and said second OPM channel in a  
wavelength division multiplexing multiplexor (WDM-MUX) to produce a  
combined beam; and

transmitting said combined beam across a free-space optical channel to  
produce a transmitted beam comprising said plurality of encoded user data  
25 channels;

wherein said step for receiving said plurality of encoded user data  
channels and separating each channel from said plurality of encoded user data  
channels comprises:

demultiplexing said plurality of encoded user data channels of said  
30 combined beam in a wavelength division multiplexing de-multiplexor to  
reconstruct said first OPM channel and said second OPM channel;

in a first QPSK optical phase decoder, decoding said first OPM channel  
to produce a first group of light beams corresponding to said first group; and

35        in a second QPSK optical phase decoder, decoding said second OPM  
channel to produce a second group of light beams corresponding to said second  
group, wherein said first group of light beams and said second group of light  
beams are referred to as a plurality of received beams.

6. The method of claim 1, wherein said FEC includes forward error  
correcting codes that select viable received channels from a set of diversity  
delayed channels.

7. The method of claim 1, wherein said step for transmitting said  
plurality of encoded user data channels across a free space optical channel  
includes modulating said plurality of encoded user data channels with high-  
order modulation.

8. The method of claim 1, wherein said step for transmitting said  
plurality of encoded user data channels across a free space optical channel  
includes arbitrary combinations of ultradense wavelength division multiplexing  
and high-order modulation of said plurality of encoded user data channels.

9. The method of claim 1, wherein the number of diverse channels and  
the length of the delays are dynamically reconfigurable.

10. The method of claim 1, wherein said method is protocol independent.

11. A fade-resistant forward error correction (FEC) system for free-space optical communication, comprising:

means for encoding user input data with a FEC to produce encoded user data;

5 means for producing a plurality of encoded user data channels from said encoded user data, wherein each particular channel of said delayed encoded user data channels comprises a unique delay relative to all of the other channels of said plurality of encoded user data channels;

10 means for transmitting said plurality of encoded user data channels across a free space optical channel;

means for receiving said plurality of encoded user data channels and separating each channel from said plurality of encoded user data channels;

means for detecting each said plurality of received beams;

15 means for adjusting selected ones of said received beams so all of them are temporally equal;

means for decoding said received beams; and

means for sending the first successfully decoded received beam as a recovered user data output.